

Title: Dust interactions on small solar system bodies and technology considerations for exploration

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Abstract: Small-bodies such as asteroids and Mars' moons Phobos and Deimos have relatively unknown regolith environments. It is hypothesized that dust preserved in the regolith on the surfaces will have similar mechanical properties to lunar dust because of similar formation processes from micrometeorite bombardment, low relative gravity for slow settling times, and virtually no weathering because there is no atmosphere. This combination of processes infers that small-body dust particles will be highly angular and retain abrasive properties. The focus of this paper uses the mission architecture and engineering design for an asteroid hopper known as Hedgehog, a spherical spacecraft with several symmetric spikes used to aid with tumbling mobility in a low gravity environment. Dust abrasion considerations are highlighted throughout the paper relating to the lead authors' previous work, but act as an example of one of many important dust or regolith physical properties that need to be considered for future exploration. Measurable regolith properties are summarized in order to identify technologies that may be useful for exploration in terms of scientific return and spacecraft design. Previous instruments are summarized in this paper that could be used on the Hedgehog. Opportunities for hardware payloads are highlighted that include low mass solutions or dual-purpose instruments that can measure regolith or dust properties. Finally, dust mitigation suggestions are made for vehicles of this mobility profile.

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